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(54) Improved transfer case

(57) A transfer case of the type which includes an input shaft 14 and means for selecting low or high speed operation. The input shaft 14 drives an idler shaft 16 which in turn drives a rearward output shaft 18. A forward output shaft 20 is coaxially aligned with the rearward output shaft and includes a rearward end which is sleeved to the forward end of the rearward output shaft 18 to be supported thereby and capable of rotation relative to the rearward output shaft. A dog clutch 86 is axially slidably mounted on the rearward output shaft for rotation therewith for selective engagement and disengagement with a portion of a rearward end of the forward output shaft. The rearward output shaft 18 has bearings 72, 74 supporting it on each side of the gear 76 by way of which it is driven.

FIG. 3

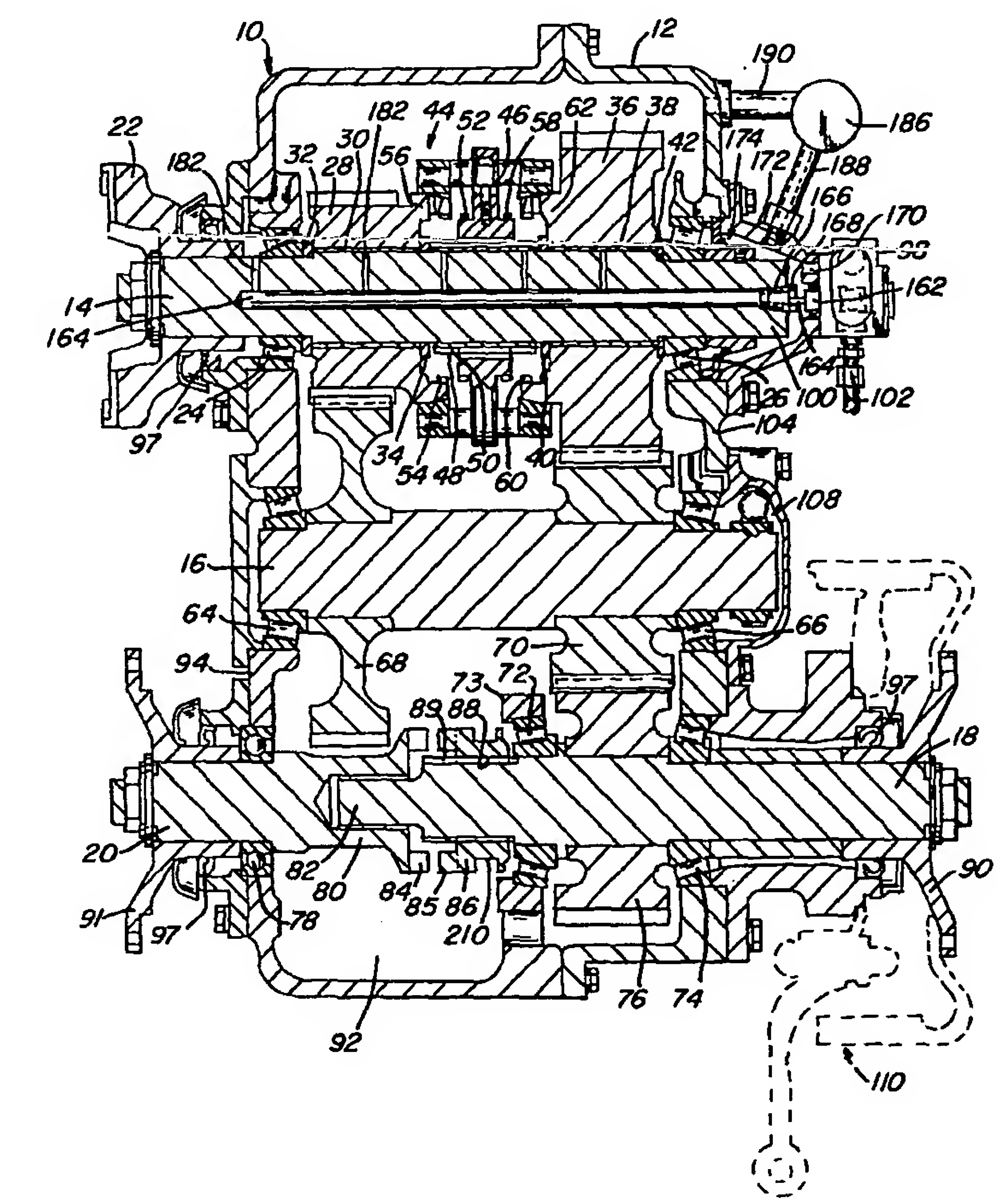

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FIG. 1

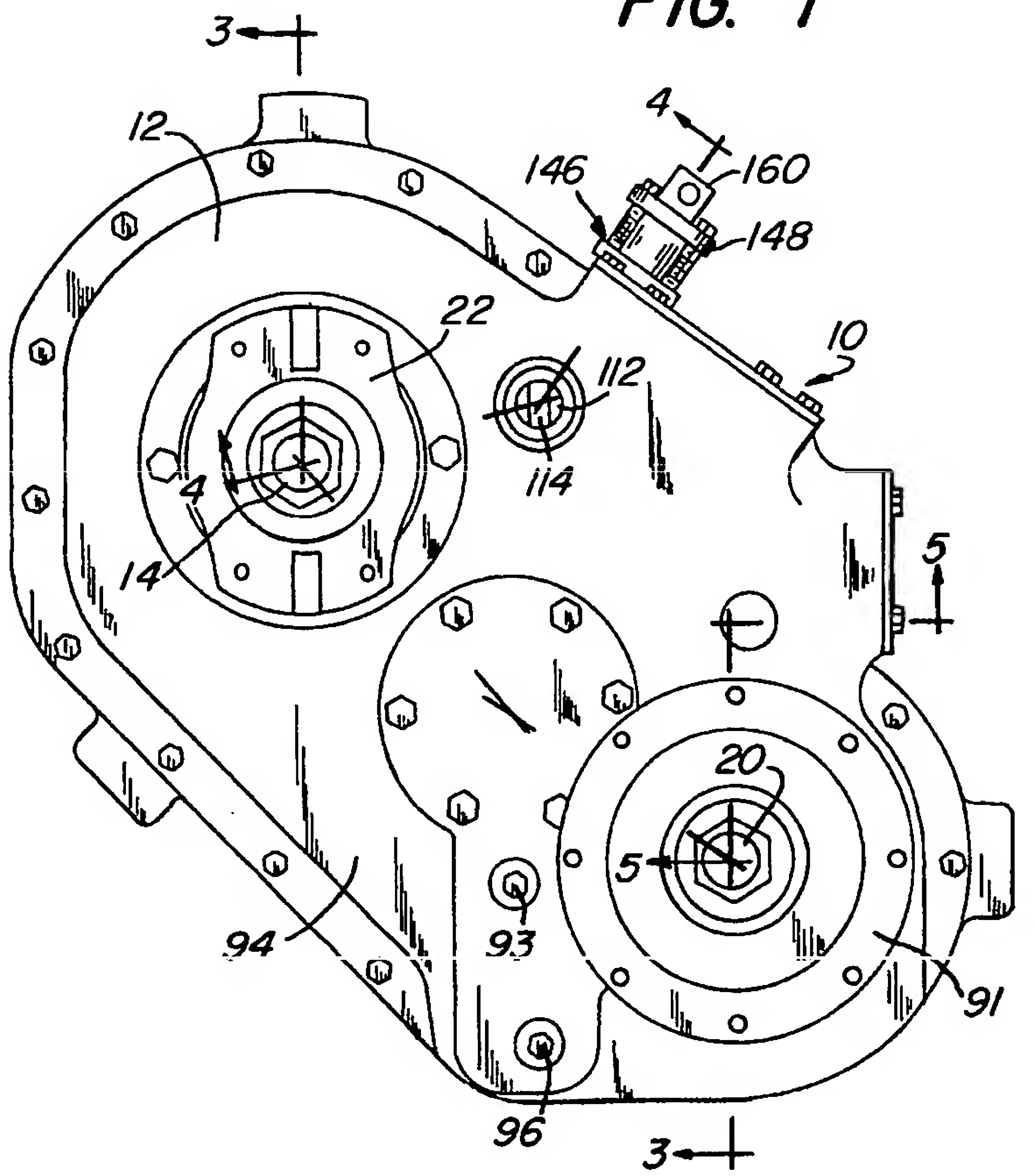

FIG. 2

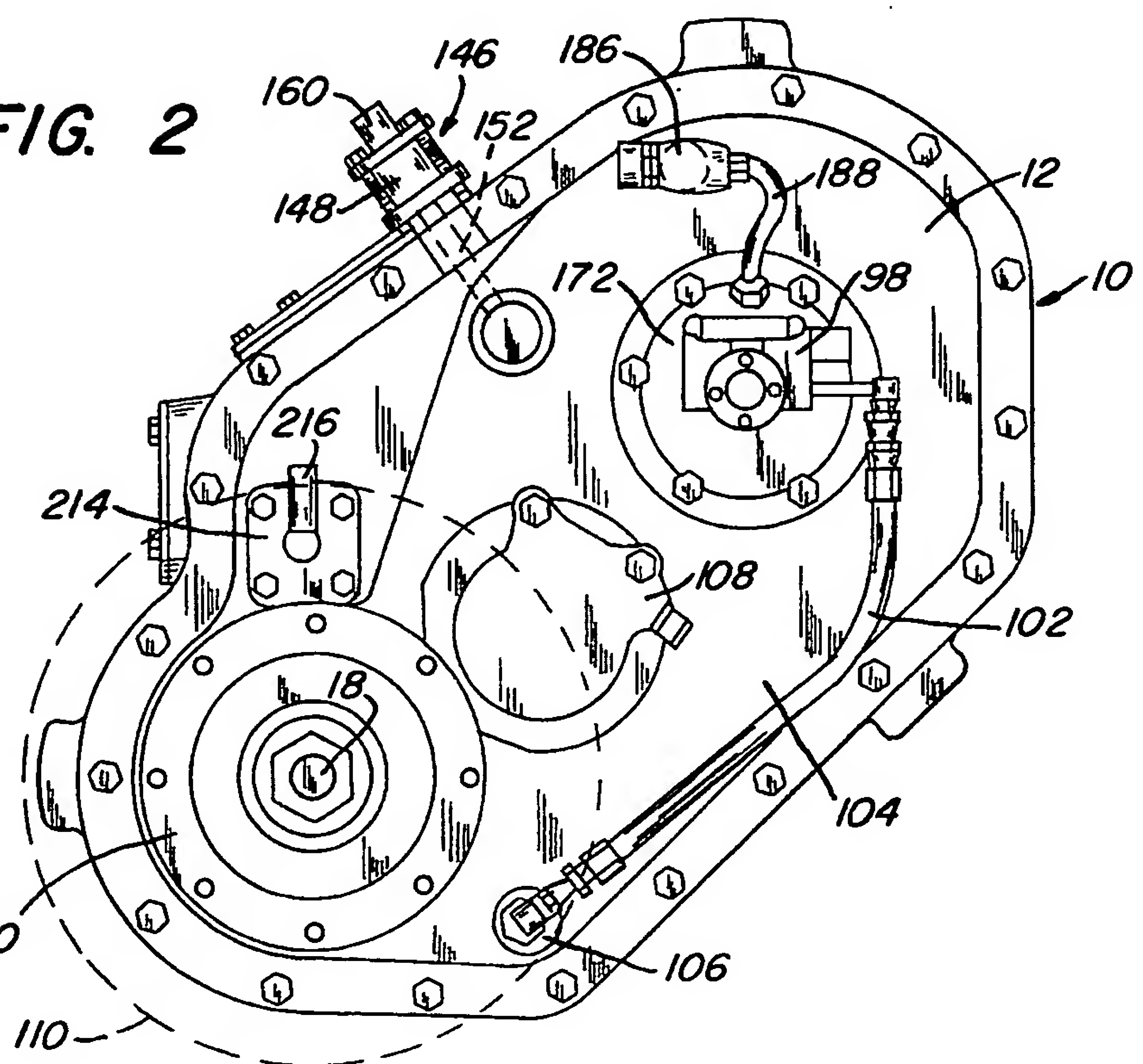

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FIG. 3

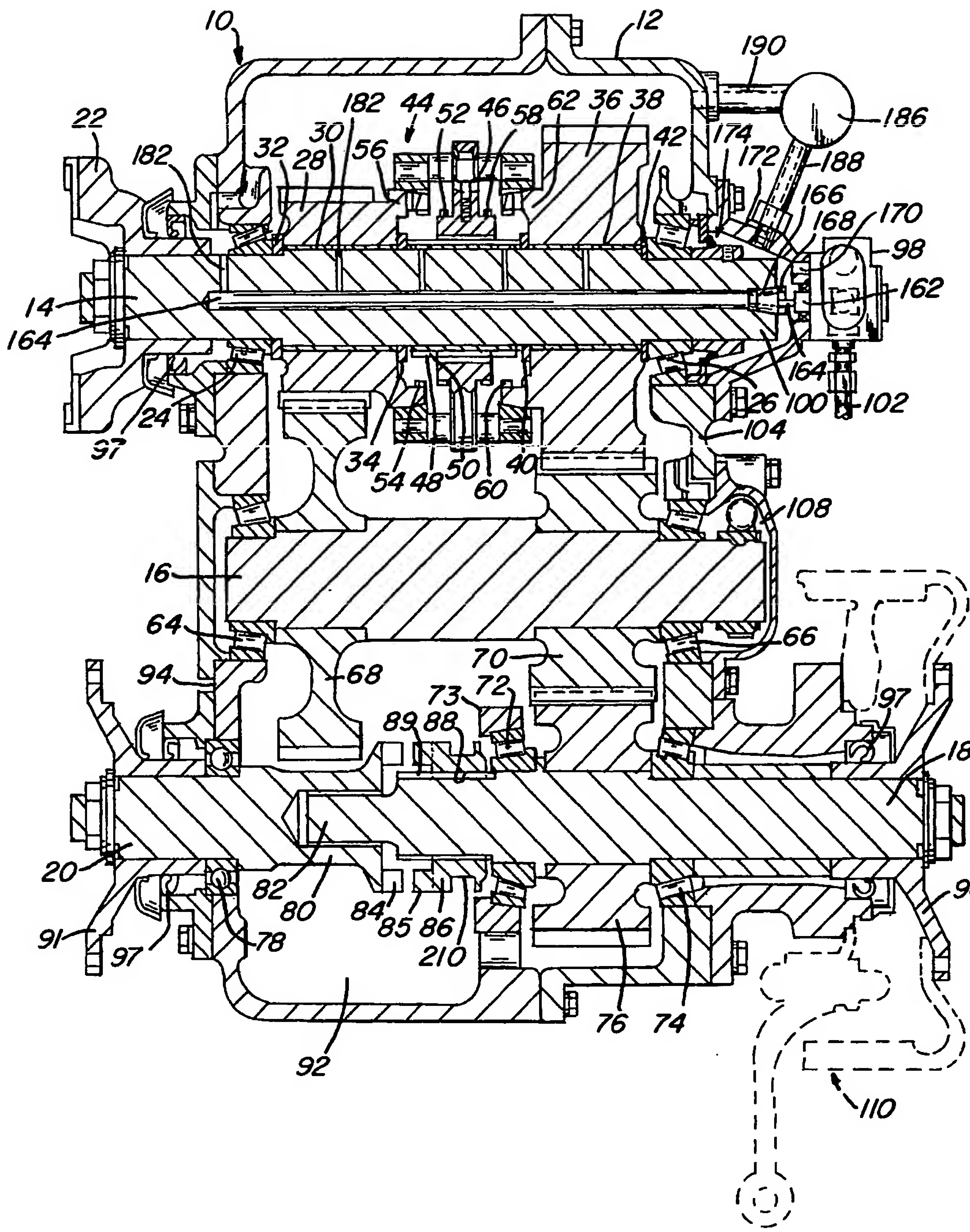

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FIG. 4

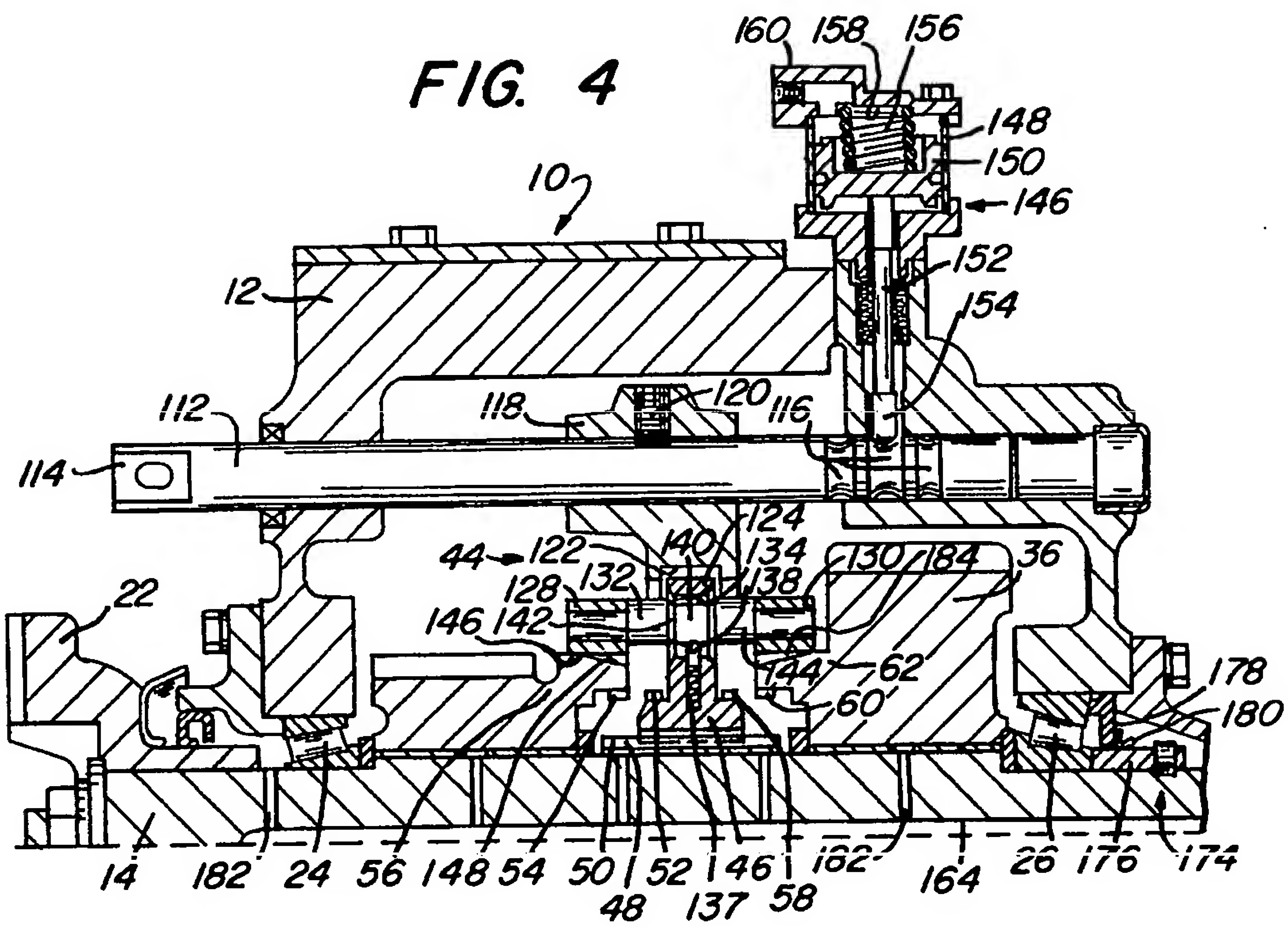
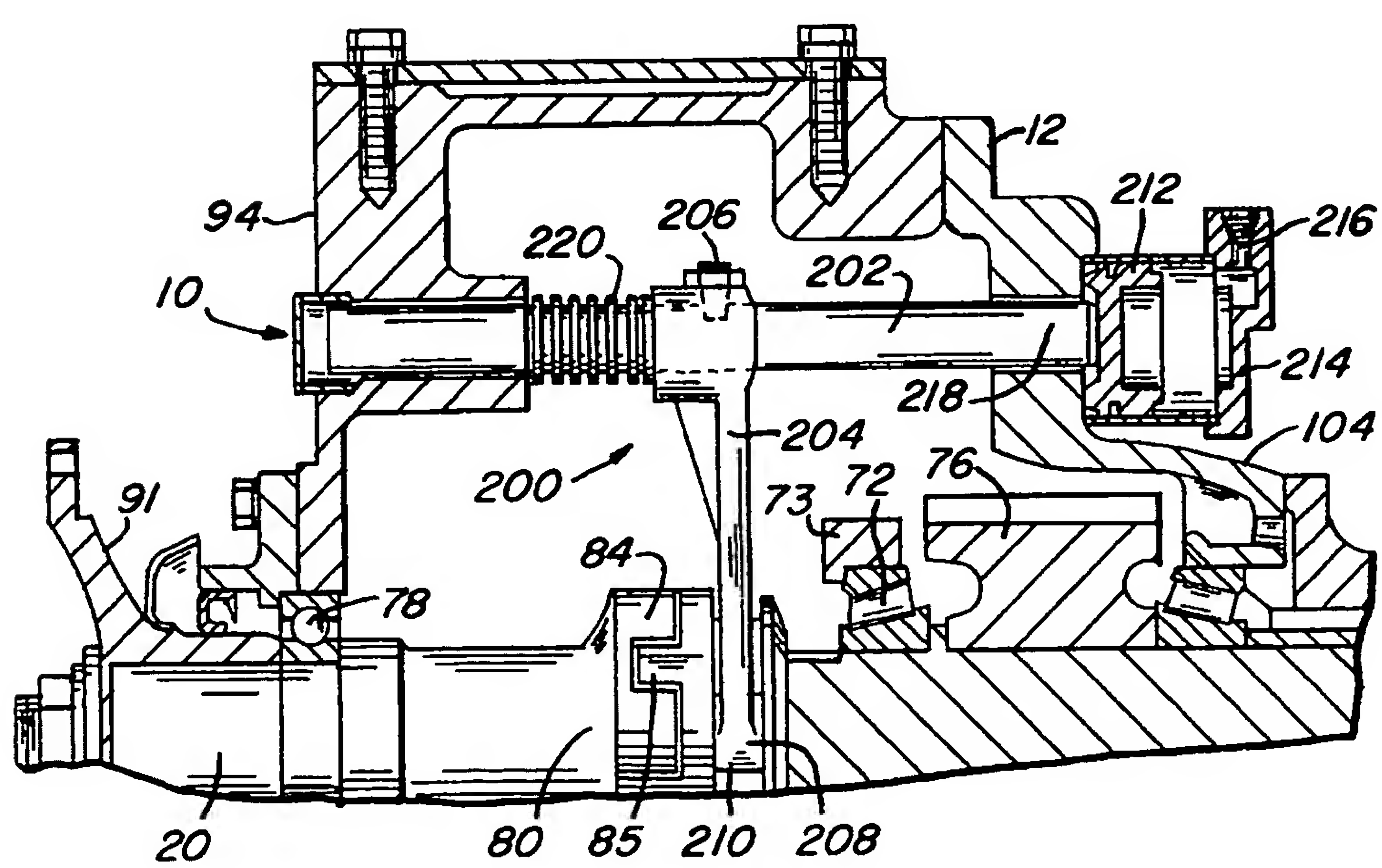


FIG. 5



SPECIFICATION

Improved transfer case

Background of the invention

Field of the invention

This invention relates to an improved transfer case and, more specifically, to such a transfer case which includes a rearward output shaft and a coaxially aligned forward output shaft and means for selectively coupling the output shafts which is located in the interior of the transfer case housing for improved operation and lubrication.

Description of the prior art

There are a number of multi-drive vehicles which utilize a main transmission and a transfer case which is capable of providing power to the rear axle along or to both the front and rear axles at the same time. Typical transfer cases of this type are disclosed in U.S. Patent Numbers 3,095,758; 3,557,634 and 3,679,016.

It is not uncommon in transfer cases to include a means for providing a multi-speed power transmission function in the form of high and low speed operation. Transfer cases such as those disclosed in U.S. Patent Numbers 3,941,199 and 4,188,838 include such features and significantly increase the selective operating gear ratios which are available to the operator of a vehicle which uses a main transmission is conjunction with the transfer case.

However, in designing transfer cases of this type, it is always if of concern that the design can be easily assembled, that no unnecessary elements are included to add to the overall weight and that the elements can be properly lubricated for effective, reliable operation of the transfer case.

Summary of the invention

It is therefore an object of this invention to provide an improved transfer case which includes features which eliminate unnecessary elements for ease of assembly and a reduction in the overall weight of the transfer case.

It is another object of this invention to provide such a transfer case in which critical elements are located in the interior of the housing a manner which facilitates lubrication during operation of the transfer case.

These and other objects of the invention are provided in a preferred embodiment thereof in the form of an improved transfer case of the type which is capable of receiving an input from a torque transmitting power source and providing an output to a rear axle configuration and to a forward axle configuration. This type of transfer case includes a housing and an input shaft mounted for rotation within the housing and coupled to the power source. A low speed gear and a high speed gear are mounted for independent rotation about the input shaft and means for selectively coupling and uncoupling one of the low speed gear and high speed gear to the input shaft for rotation herewith is also included. An idler shaft is mounted parallel to the input shaft for rotation within the housing and has a low speed idler gear and a high speed idler gear secured thereon. The low speed idler gear and the high speed idler gear are respectively in constant engaging alignment wih the low speed gear and the high speed gear to case the idler shaft to rotate in response to the rotation of one of the low speed gear and high seed gear. The improvement of the transfer case includes a rearward output shaft which is mounted parallel to the input shaft and the idler shaft for rotation within the housing and has an output gear secured thereon in constant engaging alignment with the high speed idler gear. The rearward output shaft has a rearward end extending out of the housing to be coupled to the rear axle configuration and a first support bearing secured to a rear wall of the housing between the rearward end and the output gear. The rearward output shaft has a forward end within the housing and a second support bearing secured to an interior wall of the housing between the forward end and the output gear. A forward output shaft is coaxially aligned with the rearward output shaft and mounted for rotation at an intermediate region thereof by a bearing supported at a front wall of the housing. The forward output shaft has a forward end extending out of the housing to be coupled to the forward axle configuration. The forward output shaft has a rearward end which is sleeved around the forward end of the rearward output shaft to be supported thereby while being capable of rotation relative to the rearward output shaft. There is included coupling means axially slidably mounted on the rearward output shaft for rotation therewith for selective engagement with and disengagement from a portion of the rearward end of the forward output shaft.

Brief description of the drawings

Figure 1 is a forward elevational view of the preferred transfer case which incorporates various features of the invention.

Figure 2 is a rear elevational view of the preferred transfer case which incorporates various features of the invention.

Figure 3 is a view as seen along line 3-3 of Figure 1.

Figure 4 is a view as seen along line 4-4 of Figure 1.

Figure 5 is a view as seen along line 5-5 of Figure 1.

Description of the preferred embodiment

As seen in Figures 1, 2 and 3 the preferred transfer case 10 includes various features of the invention and is of the type which is intended to be utilized in a road vehicle of the 6 × 6 type. Basically, the ouput of a conventional transmission of the road vehicle is provided to the transfer case 10 which in turn includes gearing for selective high or low speed operation to effectively double the number of speed ratios obtainable with the conventional vehicular transmission alone. Additionally, the preferred transfer case 10 includes means for selectively providing a power output to a rear axl configuration alone or for dividing the output between both a forward axle configuration and the rear axle con-

figuration.

The basic working elements of the transfer case 10 are generally enclosed within a housing 12 and include an input shaft 14, an idler shaft 16, a rearward output shaft 18 and a forward output shaft 20. An input coupling 22 is rigidly secured to the input shaft 14 and direcly receives the output from the vehicle transmission (not shown). The input shaft 14 is mounted for rotation at forward bearings 24 and rear bearings 26. A low speed gear 28 includes a sleeve bering 30 and is mounted for rotation about the input shaft 14. The spacers 32 and 34 at each side of the low speed gear 28 maintains the gear 28 at an axial position adjacent the bearings 24. Similarly, a high speed gear 36 includes a sleeve bearing 38 for rotation around the other end of the input shaft 14. Spacers 40, 42 are again utilized to retain the high speed gear 36 adjacent the bearings 26 of the input shaft 14.

A shift mechanism 44 is utilized to couple the input shaft 14 to either the low speed gear 28 or the high speed gear 36 as desired. Although the shift mechanism 44 will be discussed in detail hereinbelow, basically it includes an internally toothed annular cluth collar 46 which is slidably mounted on matching extending teeth 48 of an enlarged portion 50 of the input shaft 14 between the low speed gear 28 and the high speed gear 36. To couple the clutch collar 46, and thus the input shaft 14, to the low speed gear 28, the clutch collar must be shifted axially forward toward the low speed gear 28. An array of outwardly extending teeth 52 on the forward end of the clutch collar 46 must be aligned with and in engaging contact with an array of inwardly extending teeth 54 of a rearwardly extending cylindrical projection 56 off the slow speed gear 28. Similarly, to couple the clutch collar 46, and thus the input shaft 14, with the high speed gear 36, the clutch collar 46 must be shifted axially toward the high speed gear 36. Again, an array of outwardly extending teeth 58 at the rearward side of the clutch collar 46 must be aligned with and in engaging contact with an array of inwardly extending teeth 60 on a forwardly extending cylindrical projection 62 of the high speed gear 36. Although, the shift mechanism 44 might be in a neutral position so that neither the low speed gear 28 nor the high speed gear 36 is actually coupled to the input shaft 14, it cn be seen that the clutch collar 46 of the shift mechanism 44 is designed to insure that only one of the gears 28, 36 can be coupled to the input shaft 14 at one time.

The idler shaft 16 is utilized to transfer power from either the low speed gear 28 or the high speed gear 36 to the rearward output shaft 18. The idler shaft 16 is mounted for rotation within the housing 12 at forward bearings 64 and rear bearings 66. A low speed idling gear 68 is rigidly secured to the idler shaft 16 at the forwarding end ther of to be in alignment with and in constant engaging contact with the low speed gear 28. Similarly, a high speed idling gear 70 is rigidly mounted to th idler shaft 16 at the rear end thereof in alignm nt with and in constant engaging contact with the high speed gear 36. Although the gears 28, 68 and the gears 36, 70 will remain respectively engaged throughout operation of the transfer case 10, it can be seen that only one of the gears 28, 36 will be directly coupled to the input shaft 14 to transmit the force which is applied to the idler shaft 16 to cause it to rotate.

The rearward output shaft 18 is mounted for rotation within the housing 12 at forward bearings 72 which are supported by an interior wall 73 of the housing 12 and rearward bearings 74 at the rearward wall 104 of the housing 12. An output gear 76 is rigidly secured to the output shaft 18 between the bearings 72, 74 to be aligned with and in constant engaging contact with the high speed idling gear 70 of the idler shaft 16. Therefore, rotation will be imparted to the output shaft 18 through the idler shaft 16 independently of which gear 28, 36 of the input shaft 14 is actually being utilized. Whenever one of the input gears 28, 36 is coupled to the input shaft 14 through the shift mechanism 44, the other input gear 36, 28 is capable of independent relative rotation the input shaft 14 as it is being driven under a no-load condition by its respective idling gear 70, 68 of the idler shaft 16.

As seen in Figure 3, the forward output shaft 20 is coaxially aligned with the rearward output shaft 18 but is not actually coupled for rotation with the rearward output shaft 18. The shaft 20 is mounted at an intermediate region thereof at bearings 78 in the forward wall 94 of the housing 12 and is sleeved at its rearward end 80 to closely encircle and rotate about a forwardly extending end portion 82 of the rearward output shaft 18. The sleeve 80 includes rearwardly extending teeth or dog lugs 84 thereon which are adapted to engage the matching teeth or lugs 85 of a dog clutch 86 when power is to be sent to both of the output shaft 18, 20. The dog clutch 86 includes an internally splined hole 88 which is slidably mounted on an axially, aligned splined region 89 of the rearward ouput shaft 18. As a result, coupling between the output shaft 18 and the output shaft 20 can be accomplished by selective movement of the dog clutch 86 axially in a forward direction to cause the lugs 85 to make engaging contact with the dog lugs 84 of the forward output shaft 20.

As thus explained the output shafts 18 and 20 and the means for coupling them are well located within the interior of the housing 12. In one prior art configuration, the rearward output shaft was significantly longer and extended well forward of the low speed idler gear. Consequently, an extended housing portion had to be added to the main housing to include the foward output shaft and coupling means therein. Additionally, in this prior art configuration, the forward output shaft was provided a rearwardly extending end portion which was received within a sleeved, forward end of the rearward output shaft. As a result, a clutch with rearwardly extending teeth was axially, slidably mounted at the rearward end of the forward output shaft. A radially extending end portion had to be rigidly mounted on the forward end of the rearward output shaft to support the matching teeth which complicated assembly and installation.

As thus explained, the pref rred transfer case 10, when installed in a vehicle, provides for selective

high or low speed operation of the rearward output shaft 18 which is coupled at 90 to a drive shaft of the rear axle configuration (not shown) or of both the rearward output shaft 18 and the forward output shaft 20 which is coupled at 91 to a drive axle of for the forward axle configuration (not shown). However, it is appropriate to discuss other features of the preferred transfer case 10 which are needed for its proper operation prior to a detailed discussion of the means employed for selecting high or low speed operation and the means employed for coupling and uncoupling the forward output shaft 20.

Basic lubrication for the transfer case 10 is provided by a supply of lubricating oil in an oil sump 92 in the lower region of the housing 12. The oil is generally transmitted to the working elements and the mounting bearings mentioned hereinabove through splash lubrication. An oil fill hole 93 in the forward wall 94 is utilized to provide the lubricating oil at a predetermined level prior to operation of the transfer case 10. A drain port 96 is provided to drain the oil from the oil sump 92 when so desired. Associated with each of the bearings 24, 78 and 74 at the walls of the housing 12 are oil seals 97 which encircle the shafts to generally retain lubricating oil in the bearing region. The bearings 26, 64, 66 and 72 are actually located within the housing 12 and therefore do not require oil seals of this type for their proper operation.

It can now be seen how the location of the rearward output shaft 18, the forward output shaft 20 and the clutch 86 are preferable to the prior art configuration mentioned hereinabove. The rearwardly extending dog lugs 84, the dog clutch 86, and the splined region 89 of the rearward output shaft 18 are located intermediately within the housing 12 near the oil sump 92. Additionally, they are located between the low speed idler gear 68 and the high speed idler gear 70 to readily receive splashed lubricating oil from the gears 68, 70 as they rotate during operation of the transfer case. The dog lugs 84 collect lubricating oil to provide a supply for the forwardly extending end portion 82 and rearward end 80 of the forward output shaft 20 which is sleeved thereon. The prior art configuration did not provide for such lubrication since these elements were located in the extended housing portion remote from the oil sump and the splashing of oil by the low and high speed idler gears. Efforts to provide lubrication through passages drilled in the rearward output shaft to its forward end were not as effective as the preferred configuration of the present invention.

Because of the location of the input shaft 14 at the upper region of the housing 12 and because of the relative motions which are capable of existing during normal operation between the low speed gear 28, the shift mechanism 44, the high speed gear 36 and the input shaft 14, additional means for lubricating these elements is provided in the preferred transfer case 10 by an oil pump 98 at the rearward end 100 of the input shaft 14. The lubricating pump 98 tak s a suction on a supply line 102 which runs along a rearward wall 104 of the transfer case 10 to receive oil from the oil sump 92 through a filter at a fitting 106 at the base of the housing 12. A details operation and explanation of the oil pump 98 will be provided hereinbelow. A speedometer device 108 is also provided on the rearward wall 104 and is of the worm gear type and directly measures the speed o the idling gear 16. A parking brake 110 (shown in phantom in Figures 2 and 3) is associated with the coupling 90 of the rearward output shaft 18 and is operated in a manner well known in the prior art.

As seen in Figure 4 the shift mechanism 44 is basically operated to selectively provide either high speed or low speed operation through the axial positioning of a shift rod 112. Linkage (not shown) is coupled to the forward end 114 of the shift rod 112 which is basically designed to be positioned in one of three positions relative to the housing 12. Although, as will be explained in detail hereinbelow, three circumferential grooves 116 are provided at the rearward end of the shift rod 112 to be capable of acting in cooperation with a spring-loaded ball device in the prior art, it is sufficient at this time to understand that the shift rod 112 can be selectively moved between these three positions in the preferred transfer case 10 when shifting in and out of high and low speed is proper and desired. As shown in Figure 4 the shift mechanism 44 is in the neutral position with neither the low speed gear 28 nor the high speed gear 36 being coupled to the input shaft 14. The clutch collar 46 is centrally located on the extending teeth 50 of the input shaft 14. The position of the clutch collar 46 is determined by the position of a fork 118 which is in turn determined by the position of the shift rod 112 to which the fork 118 is rigidly keyed at 120. The fork 118 includes an internal groove 122 which partially encircles the outer cylindrical periphery 124 of the clutch collar 46.

However, for the shift mechanism 44 to properly function to select either high or low speed operation, it is not sufficient for there to be simply provided linkage and gearing to properly couple the elements in a manner which will transmit torque. It is also essential to provide means to insure that the elements to be coupled will be rotating at the same relative speed in order for the matching gears to mesh. This is accomplished in the preferred transfer case 10 by the incorporation of clutch collar 46 within a synchronizer 126. The synchronizer 126 includes a pair of synchronizer rings 128, 130 which are respectively associated with the rearwardly extending cylindrical projection 56 of the low speed gear 28 and the forwardly extending cylindrical projection 62 of the high speed gear 36. The synchronizer rings are made of brass and are axially separated but joined one to the other in the preferred synchronizer 126 by six evenly distributed pins 132 extending th rebetween. Six evenly spaced holes 134 around the clutch collar 46 are adapted to receive the pins 132 therethrough so that during operation of the synchronizer 126 and the clutch collar 46 th ntire assembly will rotat with the input shaft 14. Accordingly, as explained hereinabove, as the clutch collar 46 is moved axially to provide the desired selective high or low speed operation, the clutch collar 46 is required to slide

axially along each pin 132.

The clutch collar 46, however, is not free to slide unrestricted relative to the pins 136 because of two features which are incorporated into the synchronizer 126. The first feature includes a plunger and spring 137 which is provided within the interior of the clutch collar 46 at each hole 134 therethrough. The plunger is adapted to be received within a detent 138 which is in the interior surface of each pin 132 in an axially central location thereon. Therefore, the plunger and spring 137 will be received within the detent 138 when the clutch collar 146 is in the neutral position, as shown in Figure 4, so that this relative axial position will be maintained until a positive force is provided by the fork 118 to otherwise position to clutch collar 46. Secondly, each pin 132 is provided a circumferential groove 140 in the central location thereon so that each hole 134 in the clutch collar 46 will be positioned within the circumferential groove 140 when the clutch collar 46 is in the neutral position. The circumferential groove 140 is provided an inclined surface 142 at each end thereof which terminates at the outer cylindrical surface 144 at each end of the pin 132. Accordingly, while the interior dimensions of the hole 134 in the clutch collar 46 is capable of receiving the cylindrical surface 144 therein, when the clutch collar 46 is in the neutral position, the hole 134 must be properly aligned within the groove 140 before the cylindrical surface 144 can be received therein. In other words, if the hole 134 is not properly aligned with the cylindrical surface 144, the appropriate inclined surface 142 will act upon the edge of the hole 134 (with the application of sufficient axial force being provided to the clutch collar 46) to rotate the clutch collar 46 relative to the pins 132 until proper alignment is accomplished.

During operation in the neutral position as shown in Figure 4, each synchronizer ring 128, 130 is free to rotate relative to the respective cylindrical projection 56, 62. However, each synchronizer ring 128, 130 is provided an interior frustoconical surface 146 which is adapted to make sliding contact with a matching frustoconical surface 148 on its respective cylindrical projection 56, 62. Accordingly, the surfaces 146, 148 are capable of making sliding contact but the application axial force on the synchronizing ring 128, 130 will increase the frictional contact between the surfaces 146, 148 until the synchronizing ring 128, 130 rotates at the same relative speed as its respective cylindrical projection 56, 62.

To fully understand the operation of the shift mechanism 44 and the clutch collar 46 as thus explained, it is perhaps best to give an example of a typical gear shifting operation. Assuming the shift mechanism 44 is in a position for low speed operation, the clutch collar 46 is axially positioned forward so that the teeth 52, 54 ar engag d at the input shaft 14, clutch collar 46, synhronizer 126 and the low speed gear 28 are all rotating at the same speed. Further, assuming that the proper engine and transmission conditions are met so that the transfer case 10 can be shifted to high speed operation, the associated linkage will be operated t mov the shift rod 112 axially, rearwardly. Although they will be explained hereinabove, it is better at this time to disregard any r strictive forces that might act on the grooves 116 of the shift rod 112. Accordingly, the shift rod 112 will move axially rearwardly to cause the fork 118 to operate on the clutch collar 46 to disengage the teeth 52, 54, as the clutch collar 46 slides along the rods 132. When the neutral position is obtained, the plunger and spring 137 will be seated in the detent 138 at each rod 132 to center the clutch collar 46 thereon in a position within the circumferential groove 140 of each rod 132.

In an effort to shift to high speed operation, continued force in an axial rearward direction will cause the work 118 to act on the clutch collar 46. However, the clutch collar 46 is not free to move rearwardly, since it is now positioned within the circumferential groove 140 of each pin 132, without making interfering contact with the inclined surface 142. The interfering contact with the inclined surface 142 causes the clutch collar 46 to apply an axially rearwardly directed force to the synchronizer 126 to bring the surfaces 146, 148 of the synchronizing ring 130 of the cylindrical extension 62 into increasing sliding contact. If, as expected, the high speed gear 36 would be rotating at a relatively lower speed than the aforementioned elements, the contact between the surfaces 146, 148 would produce a braking force on the synchronizer 126. However, since the clutch collar 46 is directly coupled to the input shaft 14 there is continuing contact between the clutch collar 46 and the inclined surfaces 142 which prevents proper alignment of the holes 134 in the clutch collar 46 with the cylindrical surface 144 of each pin 132. This interfering contact between the clutch collar 46 and the inclined surface 142 will continue until the relative speed of the synchronizing ring 130 and the cylindrical projection 62 (and thus the speed speedgear 36) are almost identical. As a result, the input shaft 14 would be caused to rotate at the same speed as the high speed gear 36. Once the input shaft 14 and the high speed gear 36 are rotating at the same speed, continued force by the fork 118 on the clutch collar 46 will cause the clutch collar 46 to make sliding contact with the inclined surface 42 causing it to be aligned with the cylindrical surface 144 of the pin 132 at the rear end thereof. Once this alignment is obtained, the clutch collar 46 can move axially rearwardly and the teeth 58, 60 are properly aligned for engagement.

It should be clear that a similar operation will result if it is desirable to shift from the high speed operation to the low speed operation as the synchronizer 126 again insures that the speeds are properly matched and that the gears can be properly aligned for engagement. It should also be clear that the shift mechanism 44 would operate in a similar manner even if the clutch collar 46 were initially located in a neutral position and either high or low speed operation was desired.

As mentioned hereinabove, the grooves 116 have been employed in the prior art to also create forces on the shift r d 112 to affect its position during shifting. A spring-loaded ball detent configuration was utilized for this purpose in the prior art and generally established "preferred" axial positioning

of the rod during shifting operation. In the preferred transfer case 10, an interlock device 146 satisfi s this function and includes other features which are desirable for proper transfer case operation.

The preferred interlock device 146 includes a means for preventing any selective axial positioning of the shift rod 112 from one position to another if there is the possibility of any torque being transmitted to the transfer case which might interfere with the shifting operation. The interlock device 146 includes a power cylinder 148 which is mounted to the housing 112 in general alignment with the portion of the shift rod 112 which includes the circumferential grooves 116. Disposed within the power cylinder 148 is a piston 150 and a piston rod 152 which terminate at a rod position locating device 154 whic replaces the ball element in the prior art spring-loaded bell detent configuration. During normal operation, a spring 156 within the power cylinder 148 is in a compressed state between the piston 150 and the interior end wall 158 of the cylinder to provide biasing to the position locating device 154. Accordingly, the position locating device 154 is biased toward the exterior surface of the shift rod 112 to resist selective axial positioning of the shift rod 112 from one circumferential groove 116 to another during normal operation. In the preferred interlock device 146, normal selective operation can only occur if the basic transmission for the vehicle is placed in neutral so that no torque can be transmitted from the vehicle motor through the transmission to the transfer case 10 during shifting operation.

Accordingly, the preferred interlock device 146 utilizes a supply of pressurized air at an inlet 160 to create a force on the piston 150 whenever the vehicle transmission is in any condition other than in neutral. When the vehicle is in a power mode, the pressurized air is designed to create a sufficient force on the piston 150, the rod 152 and the position locating device 154 to cause the position locating device 154 to be firmly retained within the appropriate circumferential groove 116. Any effort to shift the transfer case 110 during this power mode would be so resisted by insertion of the position locating device 154 within the groove 116 that axial repositioning of the shift rod 112 would be prevented. Therefore, during normal operation, the shift rod 112 can be positioned at any selected axial positioning against the resistance created by the biasing of spring 156 and will generally be retained in the selected position as the position locating device 154 is fully seated in the appropriate circumferential groove 116. However, once power is again applied to the transfer case 18 at the input shaft 14 as the transmission is taken out of the neutral mode, this condition is sensed in the vehicular control system (not shown) in a manner well known in the prior art and a control signal is transmitted to supply the pressurized air to the inlet 160 to thus prevent any further axial positioning of the shift rod 112. Once the transmission is returned to a neutral mode, the system would sense this condition and relieve the pressurized air from the power cylinder 146 to allow the transfer case 10 to be returned to a condition which would allow normal shifting operation.

As mentioned hereinabove, the location of the input shaft 14 at the upper region of the housing 12 and the relative motions which exist betwe n the low speed gear 28, the shift mechanism 44, the high speed gear 36 and the input shaft 14 make it desirable that additional means for lubrication be provided by the oil pump 98. The oil pump 98 can be either a vane or gear type of lubricating pump well known in the prior art but the gear type has been specifically employed in the operation of the preferred transfer case 10. As seen in Figure 3, the pump 98 includes a drive shaft 162 which includes a keyed extension 164 directed toward the input shaft 14. The input shaft 14 includes an axial bore 164 and has at its rearward end an internal splined region 166. A hollow plug 168 with a central bore extending axially therethrough is adapted to be rigidly received within the internal splined region 166. The plug 168 has a slot in the surface of the end thereof which receives the keyed extension 164 to effectively couple the input shaft 14 and the drive shaft 162 of the pump 98. Accordingly, the pump 98 will be caused to operate during any rotational movement of the input shaft 14 and is thus capable of providing lubrication to the various elements associated with the input shaft 14.

During rotation of the input shaft 14, the oil pump 98 takes a suction on the supply line 102 and discharges lubricating oil under pressue at an outlet 170. The outlet 170 communicates with the interior of an extended portion 172 of the housing 12 which encircles the rearward end 100 of the input shaft 14. The interior of the extended portion 172 is basically sealed for lubricating purposes by the inclusion on the rearwad end 100 of the input shaft 14 of a sealing device 174 (best seen in Figure 4). The sealing device 174 includes a collar 176 which encircles the rearward 100 of the input shaft 14 and is keyed thereto. A ring 178 is firmly secured between the bearing 26 and the extended portion 172 to closely encircle the collar 176. A seal 180 is mounted on the collar 176 to make sliding, sealed contact with the ring 178 to effectively retain the lubricating oil under pressure within the interior of the extended portion 172 by effectively preventing any significant leakage around the exterior of the input shaft 14 to the region of the bearing 26 and the full interior of the housing 12.

Accordingly, the oil pressure is allowed to build up within the interior of the extended portion 172 and the lubricating oil is forced to flow through the central hole in the hollow plug 168 and into the bore 164 in the interior of the input shaft 14. A plurality of radially extending ports 182 extend from the bore 164 and provide lubrication to the various elements associated with the input shaft 14. Specifically, it can be seen that lubricating fluid provided within the interior of the synchronizer 126 will insure that its proper operation will not be interrupted by lack of lubrication. Because of the significant friction which is generated between the surfaces 146 and 148, as discussed hereinabove, a plurality of axially extending lubricating grooves 184 is provided for each synchronizing ring 128, 130.

To insure that the pressure of the lubricating oil does not exceed a desired operating pressure at th various elements associated with the input shaft 14,

a relief valv 186 communicates with the int rior of the extended portion 172 through a line 188 and is capable of discharging lubricating oil through a discharge line 190. If the pressure exceeds the design pressure, the lubricating oil will then be discharged through the discharge line 190 to the interior of the housing 12 to effectively maintain the oil pressure within the extended portion at the desired operating level.

As seen in Figure 5, a transfer mechanism 200 of the preferred transfer case 10 includes a transfer rod 202 which is mounted for axial movement within the housing 12. A fork 204 is rigidly mounted on the transfer rod 202 and keyed at 206 thereto. The extended end 208 of the fork 204 is received within a circumferential groove 210 of the dog clutch 86 so that movement of the transfer rod 202 will produce a corresponding axial movement of the dog clutch 86. As seen in Figure 5, the dog clutch 86 is shifted to a forward position to couple the output shaft 18 and the output shaft 20 so that the output of the transfer case 10 will be provided to both output shafts 18, 20.

The transfer rod 202 is shifted fowardly for the desired coupling by the action of a piston 212 within a power cylinder 214 which is mounted on the rearward wall 104 of the housing 12. Pressurized air is provided at the inlet 216 of the power cylinder 214 to force the piston 212 against the rearward end 218 of the shift rod 202. A spring 220 which is mounted in a compressed state between the forward wall 94 of the housing 12 and the fork 204 provides biasing to the transfer rod 202 in a rearward direction which will normally uncouple the output shafts 18, 20 unless the piston 212 is caused to forwardly move the transfer rod 202 for the purpose of coupling the shafts. Therefore, when in the operation of the transfer case 10 it is desired to uncouple the shafts 18, 20 the pressurized air in the power cylinder 214 is released so that the spring 220 can shift the transfer rod 202 rearwardly.

CLAIMS

1. An improved transfer case of the type which is capable of receiving an input from a torque transmitting power source and providing an output to a rear axle configuration and the forward axle configuration and includes a housing, an input shaft mounted for rotation within said housing and coupled to said power source, a low speed gear and a high speed gear mounted for independent rotation about said input shaft, means for selectively coupling and uncoupling one of said low speed gear and said bigh speed gear to said input shaft for rotation therewith, an idler shaft mounted parallel to said input shaft for rotation within said housing and having a low speed idler gear and a high speed idler gear secured thereon, and said low speed idler gear and said high speed idler gear being respectively in constant engaging alignment with said low speed gear and said high speed gear to cause said idler shaft to be rotated in response to the rotation of said one of said low speed gear and said high speed gear, said improvement comprising:

a rearward output shaft being mounted parallel to said input shaft and to said idler shaft for rotation within said housing and having an output gear secured thereon in constant ngaging alignment with said high speed idler gear;

said rearward output shaft having a rearward end extending out of said housing to be coupled to said rear axle configuration and a first support bearing secured to a rear wall of said housing between said rearward end and said output gear;

said rearward output shaft having a forward end within said housing and a second support bearing secured to an interior wall of said housing between said forward end and said output gear;

a forward output shaft being coaxially aligned with said rearward output shaft and mounted for rotation at an intermediate region thereof by a bearing supported at a front wall of said housing;

said forward output shaft having a forward end extending out of said housing to be coupled to said forward axle configuration;

said forward output shaft having a rearward end which is sleeved around said forward end of said rearward output shaft to be supported thereby while being capable of rotation relative to said rearward output shaft; and

coupling means axially slidably mounted on said rearward output shaft for rotation therewith for selective engagement with and disengagement from a portion of said rearward end of said forward output shaft.

2. The improved transfer case as set forth in Claim 1, wherein said rearward output shaft includes a region between said forward end and said second support bearing including axially aligned splines and said coupling means includes a clutch having an internally splined hole therethrough to be received on said region of said rearward output shaft.

3. The improved transfer case as set forth in Claim 2, wherein said portion of said rearward end of said forward output shaft extends radially outwardly to support axially, rearwardly extending teeth and said clutch includes axially, forwardly extending teeth which are capable of making aligned engaging contact with said teeth of said portion of said rearward end of said foward output shaft to cause said forward output shaft to rotate with said rearward output shaft.

4. The improved transfer case set forth in Claim 3, wherein said portion of said rearward end of said forward output shaft and said region of said rearward output shaft are located intermediately within the interior of said housing in a lower part thereof which includes a sump of lubricating oil between said low speed idler gear and said high speed idler gear to be subjected to splash lubrication therefrom during operation of said transfer case.

5. The improved transfer case as set forth in Claim 4, wherein said axially, rearwardly extending teeth collect said luricating oil from said splash lubrication to provide a supply of said lubricating oil for said forward end of said rearward output shaft and said rearward end of said forward output shaft sleeved thereon.

6. The improved transfer case as set forth in Claim 4, further including means for axially position-

ing said clutch including a transfer rod mounted for axial movement within said housing and having a fork means rigidly mounted thereon, said fork means including an extended end which is received within a circumferential groove around said clutch.

7. The improved transfer case as set forth in Claim 6, wherein said means for axially positioning said clutch includes a means for biasing said transfer rod in a rearward direction and means for selectively forcing said transfer rod forwardly in opposition to said means for biasing.

8. The improved transfer case as set forth in Claim 7, wherein said means for biasing includes a spring positioned around said transfer rod under compression between said front wall of said housing and said fork means.

9. The improved transfer case as set forth in Claim 7, wherein said means for selectively forcing said transfer rod includes a power cylinder mounted on said rear wall of said housing in alignment with a rearward end of said transfer rod for applying force thereto.

10. A drive transmission transfer case substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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